



## Project Summary

# Field Demonstration of Lead-Based Paint Removal and Inorganic Stabilization Technologies

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A study was conducted to demonstrate the effectiveness of a wet abrasive blasting technology to remove lead-based paint from exterior wood siding and brick substrates, and the effectiveness of two Best Demonstrated Available Technologies (BDAT) to stabilize the resultant blasting media (coal slag and mineral sand) paint debris to reduce the leachable lead content. The average lead loading of the paint coating on the wood and brick substrates was 6.9 and 51.9 mg/cm<sup>2</sup>, respectively. The effectiveness of the lead-based paint removal technology was determined using an X-ray fluorescence (XRF) spectrum analyzer (L&K shell). The XRF measurements were corroborated by analysis of substrate samples using inductively-coupled plasma atomic emission spectroscopy (ICP-AES). The effectiveness of the technologies to stabilize the debris was evaluated through the Toxicity Characteristic Leaching Procedure (TCLP). Aerodynamic particle size distributions of lead particulate generated during paint removal were measured using a multi-stage personal cascade impactor. Personal and area air samples were collected to evaluate the potential of the wet abrasive blasting technology to generate exposure levels of lead above the OSHA Permissible Exposure Limit (PEL) of 50 µg/m<sup>3</sup>, 8 hour time-weighted average.

Wet abrasive blasting effectively removed the lead-based paint coating from both the wood and brick substrates to below the U.S. Department of Hous-

ing and Urban Development Guideline (1 mg/cm<sup>2</sup>) with minimal or no damage to the underlying substrates ( $p < 0.0001$ ). The mean area air levels of lead-containing particulate generated during paint removal were significantly below the PEL ( $p < 0.001$ ), whereas the mean personal breathing zone lead levels were approximately three times higher than the PEL. Neither of the two stabilization technologies consistently stabilized the abrasive media paint debris to achieve a leachable lead content below the RCRA regulatory threshold ( $< 5$  mg/L).

*This project Summary was developed by EPA's National Risk Management Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).*

### Introduction

The Lead-Based Paint Poisoning Prevention Act of 1971, as amended by the Housing and Community Development Act of 1987, established 1.0 milligram of lead per square centimeter of surface area (mg/cm<sup>2</sup>) as the federal threshold requiring abatement of lead-based paint on architectural components in public and Indian housing developments nationwide. The Residential Lead-Based Paint Hazard Reduction Act of 1992 (commonly referred to as "Title X") mandated the evaluation and reduction of lead-based paint hazards in the nation's existing housing. Title X also established 0.5 percent lead by weight as an alternative to

the 1.0 mg/cm<sup>2</sup> threshold. An U.S. Environmental Protection Agency (EPA) study<sup>1</sup> found that a level of 1.0 mg/cm<sup>2</sup> was roughly equivalent to 1.0 percent by weight and a level of 0.5 percent by weight was roughly equivalent to 0.5 mg/cm<sup>2</sup>.

The management of wastes generated from lead-based paint abatement activities are governed by the Resource Conservation and Recovery Act (RCRA) of 1976 and provisions contained in 40 CFR Parts 260-268. RCRA classifies any waste that leaches 5 milligrams per liter (mg/L) of lead or more (as determined by a Toxicity Characteristic Leaching Procedure<sup>2</sup>) a hazardous waste. The leachability of lead is affected by various factors, including speciation of the metal, pH of the leachate, particle size, acid flux through the waste, and time of contact with the leachant. The U.S. Environmental Protection Agency (EPA) has promulgated a list of Best Demonstrated Available Technologies (BDAT) for the inorganic stabilization of hazardous wastes including lead-containing wastes. Stabilization includes those techniques that limit the solubility of hazardous constituents in the waste.<sup>3</sup> Much of the inorganic stabilization that occurs in the United States is based on the chemistry of lime or ordinary Portland cement.

## Objective

The overall objective of this study was to demonstrate the effectiveness of a wet abrasive blasting technology combined with an inorganic-based stabilization technology to remove lead-based paint from exterior substrates (wood and brick) and to generate a non-hazardous waste for disposal.

## Study Design

This study evaluated the effectiveness of a wet abrasive blasting technology (Torbo<sup>®</sup>) combined with two inorganic-based stabilization technologies (Blastox<sup>®</sup> and PreTox 2000 Fast Dry) to remove lead-based paint from exterior substrates (brick and wood) and to generate a non-hazardous waste for disposal. Each technology combination (e.g., Torbo<sup>®</sup> with PreTox 2000 Fast Dry) was demonstrated on the two substrates (brick and wood) to yield two treatments. Each treatment was replicated three times to yield six experiments per technology combination.

**Brick** -- A single building wall (approximately 28' H x 157' L) was used as the exterior painted brick substrate. The lead loading on the brick ranged from 1.5 to 15.2 mg/cm<sup>2</sup> (average 6.9 mg/cm<sup>2</sup>, std. dev. 3.2 mg/cm<sup>2</sup>) using a NITON Model

703-A X-ray fluorescence (XRF) spectrum analyzer (K & L Shell Combined). The masonry wall was divided into six areas that ranged from 556 to 756 ft<sup>2</sup> (average 627 ft<sup>2</sup>). The differences in surface area are due to the presence of varying numbers of windows on the wall; the respective areas were subtracted from each of the test areas. Each technology combination was assigned at random to the six test areas.

**Wood** -- Five buildings with 4-inch popular wood siding were used as the exterior painted wood substrate. The buildings were located on the same property, had an identical architectural design, and reportedly had similar painting histories. The lead loading on the wood siding ranged from 13.1 to 51.9 mg/cm<sup>2</sup> (average 33.3 mg/cm<sup>2</sup>, std. dev. = 10.1 mg/cm<sup>2</sup>) using a NITON Model 703-A XRF spectrum analyzer (K & L Shell Combined). Two test areas were selected from one building and one test area was selected from each of the remaining four buildings, yielding a total of six test areas. The six test areas ranged from 294 to 431 ft<sup>2</sup> (average 363 ft<sup>2</sup>). The technology combinations were randomly assigned to the test areas.

## Technologies Evaluated

### **Torbo<sup>®</sup> Wet Abrasive Blasting System**

The Torbo<sup>®</sup> Wet Abrasive System is manufactured by Keizer Technologies of Americas, Inc. in Euless, Texas. The system uses conventional blasting abrasives mixed with water (80% abrasive to 20% water) in a pressure vessel. During this study, mineral slag was used to remove the paint from the brick and coal slag (Black Beauty<sup>®</sup>) was used to remove the paint from the wood.

The system combines the abrasive media and water to create a slurry-mixture that is fed to a blast nozzle much like a conventional blasting system. In concept, each particle of the abrasive is encased in a thin layer of water. It utilizes this coating to both reduce the heat generated by friction and form a cohesive bond for the dust created by the blasting process that reduces the fugitive particulate emissions.

### **Blastox<sup>®</sup>**

Blastox<sup>®</sup> is manufactured by TDJ Group Inc. in Cary, Illinois. Blastox<sup>®</sup>, an abrasive additive, is a di- and tri-calcium silicate-based material similar in chemical composition to Type I cement. Typically, for lead-based paint removal, it is added at a 20-25 weight percent ratio to the non-recyclable blasting media such as mineral sand or coal slag. For this study, the

supplier of the abrasive reportedly premixed the Blastox<sup>®</sup> additive at a 20 and 15 percent weight ratio to the abrasive (mineral sand or coal slag) for paint removal from the wood and brick substrates, respectively.

A U.S. Army Corps of Engineers study<sup>4</sup> concluded that Blastox<sup>®</sup> stabilizes lead-containing paint blast media wastes (i.e., reduces the leachability of lead) by a series of simultaneous reactions that result in an encapsulated lead silicate compound, which is insoluble at all pH levels. The first reaction is a pH adjustment that simultaneously stabilizes the lead by adjusting the pH range (8.0-11.5) where there is limited leachability for lead. Secondly, the chemical form of the lead is changed from a lead oxide, carbonate, or hydroxide, to a lead silicate, which is insoluble. A U.S. EPA study<sup>5</sup> concluded that Blastox<sup>®</sup> appears to stabilize the lead through an immobilization mechanism, rather than by chemical reaction of lead oxide, to form a lead silicate. Lastly, hydration reactions encapsulate the waste into a cementitious material, which limits the gravitational flow of water through the waste.

### **PreTox 2000 Fast Dry**

PreTox 2000 Fast Dry (hereafter referred to as PreTox 2000) is manufactured by NexTec, Inc. in Dubuque, Iowa. PreTox 2000 is a cementitious paint-like mixture (i.e., treatment layer) designed to be applied to lead-based paint surfaces and allowed to cure and adhere to the paint coating; it then is removed in conjunction with the underlying lead-based paint coating using abrasive blasting or other standard techniques. PreTox 2000 is composed of materials from the compounds of sodium and potassium silicates, sodium and potassium phosphate, and calcium silicate, iron and aluminum sulfates, and an alkali metal salt.<sup>6</sup> It also contains toluene, acetone, and VM&P naphtha as carrier solvents. Typically, PreTox 2000 is designed to be applied to a 10- to 60-mil (wet) thickness depending on substrate and paint condition; the average application is 40-mil (wet) thickness. For this study, the manufacturer's representative used an airless sprayer to apply PreTox 2000 to a surface of 40 mil (wet) thickness.

The manufacturer reports that the PreTox 2000 system stabilizes the lead through two mechanisms. The first mechanism is chemical stabilization through pH adjustment, which instantaneously stabilizes the lead by adjusting the pH range (8.0-11.5) where there is limited leachability for lead. The second is chemical

fixation that changes the soluble ionic form of lead to an insoluble metallic form. Test data provided by NexTec, Inc. showed that PreTox 2000 successfully stabilized lead-based paint debris, yielding a leachable lead content of <5 mg/L using both the TCLP and Multiple Extraction Procedure (MEP).

## **Sampling and Analytical Methods**

### ***Thickness of Dry Paint Film***

The measurement of dry film thickness of the paint was made using ASTM Method D 4138-88.

### ***Lead in Dry Paint Film***

Lead in paint measurements (XRF and ICP-AES) were made before paint removal to establish the lead loading on the test panel. The measurements were made at approximately the same five locations as the paint film thickness measurements. The measurements were made in accordance with Chapter 7 "Lead-Based Paint Inspection" (1997 Revision) of the HUD Guidelines.

### **XRF Measurements**

A NITON XRF Spectrum Analyzer (Model 703-A) running software Version 5.1 was used to determine the lead loading on the brick and wood substrates. The instrument was operated in the variable-time paint test mode "K & L + Spectra" using the "Combined Lead Reading" with the instrument display of a 95% confident (2-sigma) positive or negative determination versus the threshold-level (1 mg/cm<sup>2</sup>) as the stopping point of the measurement. There is no inconclusive classification when using the threshold for this instrument running software version 5.1.<sup>11</sup> Results are classified as positive (i.e.,  $\geq 1.0$  mg/cm<sup>2</sup>), if greater than or equal to the threshold, or negative (i.e.,  $< 1.0$  mg/cm<sup>2</sup>) if less than the threshold. The instrument reads until a 95% confident reading of "Positive" or "Negative" versus the threshold (1 mg/cm<sup>2</sup>) is achieved.

### ***Paint Chip Sampling***

A paint chip sample for ICP-AES analysis was obtained at approximately the same location as three of the five XRF measurements. Each sample was obtained from a 1¼-inch by 1¼-inch (approximately 3.17-cm by 3.17-cm) square area. The samples were prepared for analysis in accordance with EPA SW-846 Method 3050 and analyzed by ICP-AES in accordance with EPA SW-846 Method 6010. The analytical limit of detection was reported as 5 µg/sample.

### ***Lead on Bare Substrate***

Lead on bare substrate measurements (XRF and ICP-AES) were made after paint removal to establish the residual lead loading in the test area. The six wood siding test areas and the six brick wall test areas were each equally dimensioned into 25 areas (i.e., grid squares). The measurements were made at the approximate center point of each grid square. An XRF measurement was made in each of the 25 grid squares. A bare substrate sample for ICP-AES analysis was collected from five of the 25 squares; the test locations were randomly selected.

### ***Lead in Airborne Particulate***

#### **Personal Breathing Zone Samples**

Personal breathing zone and work area air samples were collected during each technology demonstration. The samples were collected and prepared for analysis by ICP-AES in accordance with NIOSH Method 7300.

#### **Lead Particulate Aerodynamic Particle Size Distribution**

An 8-stage Marple Personal Cascade Impactor (Model 298) was used to determine the aerodynamic particle size distribution of the lead particulate generated during each technology demonstration. The samples were collected and prepared for analysis by ICP-AES in accordance with NIOSH Method 7300.

### ***Characterization of Abrasive Media Paint Debris***

Representative samples of the abrasive media paint debris (spent abrasive, stabilization product, paint chips/particles) were collected to determine whether the material generated from a technology combination was a RCRA (40 CFR Part 261) hazardous waste based on the Toxicity Characteristic Leaching Procedure (TCLP). The samples were extracted in accordance with EPA SW-846 Method 1311, digested in accordance with EPA SW-846 Method 3015, and analyzed in accordance with EPA SW-846 Method 6010.

### **Statistical Methods**

All comparisons of two sample means were made using a standard two-sample t-test. If the distributional assumption of normality was not reasonable, then the corresponding nonparametric distribution-free method was used (i.e., Wilcoxon Rank Sum Test). All one-sample comparisons to a regulatory action level (1 mg/cm<sup>2</sup>) were made using a standard one-tailed t-test. Again, if the distributional as-

sumption of normality was not reasonable, then the corresponding nonparametric method was used (i.e., Signed Rank Test). All of these statistical comparisons were made at the 0.05 level of significance. The upper limit of the 80 percent confidence interval for the mean concentration of leachable lead in the abrasive media paint debris was calculated to determine if the material was a RCRA hazardous waste.<sup>7</sup> If the mean concentration of leachable lead plus the 80 percent confidence interval is greater than the regulatory threshold (5 mg/L), the material was considered to be a hazardous waste.

## **Results and Discussion**

### ***Effectiveness of Paint Removal***

#### **XRF Measurements Before and After Paint Removal**

Tables 1 and 2 present descriptive statistics for the XRF measurements obtained before and after paint removal on wood and brick substrates, respectively, for each technology combination. A one-tailed t-test was used to determine whether the mean lead concentration after paint removal was significantly less than 1 mg/cm<sup>2</sup> both by substrate (i.e., wood and brick) and overall for each technology combination. In every case, both by substrate and overall, the results show that both Torbo®-Blastox® and Torbo®-PreTox 2000 reduced lead concentrations on wood and brick to a level significantly below 1 mg/cm<sup>2</sup>.

#### **Comparison of XRF Measurements and ICP-AES Analysis**

Tables 3 and 4 present descriptive statistics for the XRF measurements obtained before and after paint removal on wood and brick substrates, respectively, for each technology combination. The Wilcoxon Rank Sum Test was used to compare lead concentrations measured by XRF and ICP-AES on the wood and brick substrates both before and after paint removal. The lead concentrations determined by ICP-AES and XRF measurements before paint removal on wood were not significantly different ( $p=0.1055$ ); however, the measurements before paint removal on brick were significantly different ( $p=0.0001$ ). The lead concentrations determined by ICP-AES and XRF measurements after paint removal on wood were significantly different ( $p=0.0331$ ); however, the measurements after paint removal on brick were not significantly different ( $p=0.5504$ ).

**Table 1. Descriptive Statistics for XRF Measurements (K & L Shell Combined)  
Collected Before and After Paint Removal on Exterior Wood Siding**

Technology Combination	Lead Concentration (mg/cm <sup>2</sup> )				
	N	Mean	Std. Dev.	Minimum	Maximum
Before Paint Removal					
Torbo® with Blastox®	15	36.9	9.52	15.5	51.9
Torbo® with PreTox 2000	15	29.7	9.66	13.1	41.4
After Paint Removal					
Torbo® with Blastox®	75	0.24	0.22	0	1.1
Torbo® with PreTox 2000	75	0.16	0.16	0	0.70

**Table 2. Descriptive Statistics for XRF Measurements (K & L Shell Combined)  
Collected Before and After Paint Removal on Exterior Brick**

Technology Combination	Lead Concentration (mg/cm <sup>2</sup> )				
	N	Mean	Std. Dev.	Minimum	Maximum
Before Paint Removal					
Torbo® with Blastox®	15	5.59	1.78	1.5	9.7
Torbo® with PreTox 2000	15	8.18	3.71	3.9	15.2
After Paint Removal					
Torbo® with Blastox®	75	0.14	0.09	0	0.4
Torbo® with PreTox 2000	75	0.11	0.14	0	1.1

**Table 3. Lead Concentrations in Paint and on Wood Measured by ICP-AES and XRF (K & L Shell Combined)**

Method of Measurement	Lead Concentration (mg/cm <sup>2</sup> )				
	N	Mean	Std. Dev.	Minimum	Maximum
Before Paint Removal					
ICP-AES	18	28.2	12.8	9.1	51.6
XRF (L & K Shell)	30	33.3	10.1	13.1	51.9
After Paint Removal					
ICP-AES	30	0.37	0.50	0.01	2.68
XRF (L & K Shell)	150	0.20	0.20	0	1.10

**Table 4. Lead Concentrations in Paint and on Brick Measured by ICP-AES and XRF (K & L Shell Combined)**

Method of Measurement	Lead Concentration (mg/cm <sup>2</sup> )				
	N	Mean	Std. Dev.	Minimum	Maximum
Before Paint Removal					
ICP-AES	18	2.93	2.11	0.20	9.1
XRF (L & K Shell)	30	6.89	3.15	1.5	15.2
After Paint Removal					
ICP-AES	30	0.20	0.30	0.005	1.39
XRF (L & K Shell)	150	0.13	0.12	0	1.10

## Characterization of Abrasive Media Paint Debris

### Coal Slag Paint Debris from Wood Substrate

Table 5 presents the mean leachable lead levels and corresponding upper confidence limits for the abrasive paint debris by site and overall for both technology combinations. Overall, the abrasive paint debris from both technology combinations was determined to be a hazardous waste. If examined on a site-by-site basis, the debris is also determined to be a hazardous waste. The mean leachable lead levels in abrasive media debris generated from the removal of paint from wood by the two technology combinations were compared by using a standard two-sample t-test. The mean leachable lead level in the debris generated from the Torbo®-Blastox® combination (21.3 mg/L) was not significantly different ( $p=0.4459$ ) from the mean leachable lead level in the debris generated from the Torbo®-PreTox 2000 combination (14.8 mg/L).

### Mineral Sand Paint Debris from Brick Substrate

Table 6 presents the mean leachable lead levels and corresponding upper confidence limits for the abrasive paint debris by site and overall for both technology combinations. Overall, the abrasive paint debris from both technology combinations was determined to be a hazardous waste. If examined on a site-by-site basis, the debris is also determined to be a hazardous waste, with one exception. The two samples collected from debris at Site 1 (Torbo®-Blastox®) showed an 80% UCL of 3.9, which by itself would not be classified as a hazardous waste. The mean leachable lead levels in abrasive media debris generated from the removal of paint from brick by the two technology combinations were compared by using a standard two-sample t-test. The mean leachable lead level in the debris generated from the Torbo®-Blastox® combination (8.1 mg/L) was not significantly different ( $p=0.9555$ ) from the mean leachable lead level in the debris generated from the Torbo®-PreTox 2000 combination (7.8 mg/L).

Overall, the abrasive media paint debris characterization results (Tables 5-6) are somewhat surprising. The leachability of lead is affected by many factors including, type of lead in paint, resins used in the paint, age of the paint, particle size, and others.<sup>8-9</sup> The manufacturers of the stabilization technologies postulate that the ineffectiveness of their respective products in this study was due to insuffi-

cient product added or applied to stabilize the concentration of lead present in the paint. The reason(s) why these stabilization technologies were ineffective under the conditions of this study is equivocal.

**Blastox®**--The material supplier provided a 20% and 15% blend ratio of Blastox® with the coal slag and mineral sand abrasives for use on the wood and brick substrates, respectively. A 30% and 20% blend ratio of Blastox® with the respective abrasives would have been preferred by the manufacturer. Hence, the optimum blend ratio was not used in the demonstration. Mis-communication between the manufacturer and the abrasive supplier resulted in the incorrect blending ratio of Blastox® with the abrasive. Subsequently, the manufacturer issued a technical bulletin to minimize the probability of this blending error occurring in the future.<sup>12</sup>

**PreTox 2000**--The manufacturer of PreTox 2000 recommends a 10-40 mil (wet) thickness application; a 40 mil (wet) thickness was applied to both the wood and brick substrates. A 60 mil (wet) thickness application for the wood substrates would have been preferred by the manufacturer. Hence, the optimum application mil thickness was not used in the demonstration.

## Air Measurements

### Personal and Area Air Measurements

In all cases, the mean airborne lead levels measured by the personal breathing zone samples were significantly greater than the 50  $\mu\text{g}/\text{m}^3$  8-hour TWA (Table 7).

### Lead Particulate Aerodynamic Particle Size Distribution

Figure 1 shows the average differential lead particle size distribution for the two samples. This graph provides the particle mass concentration ( $C_i$ ) in each particle-size band versus the geometric mean diameter ( $\text{GMD}_i$ ), where  $\text{GMD}_i = D_i \times D_{i-1}$ . The lead particles generated by the wet abrasive blasting of the surface coating covers a wide-size spectrum, where the larger particles account for the greatest mass of lead. The corresponding cumulative particle size distribution was determined by preparing a log-probability plot of the particle size cut-point ( $D_p$ ) versus the cumulative percent of mass ( $\text{mg}/\text{m}^3$ ) less than the  $D_p$ . The distribution of sample weights appeared to approximate a lognormal distribution with a mass median diameter (MMD) of 8.3  $\mu\text{m}$ . That is, 50% of the particle mass is borne by

particles larger than 50  $\mu\text{m}$ . The calculated geometric standard deviation (GSD) was 3.4. By comparison, a GSD of 1 represents a monodisperse aerosol.

## Cost Analysis

A cost analysis of the Torbo®-Blastox® and Torbo®-PreTox 2000 technology combinations to remove lead-based paint from wood and brick substrates is presented in the Project Report.

## Conclusions

- Wet abrasive blasting effectively removed the lead-based paint from both exterior wood siding and brick masonry with minimal damage to the underlying substrates (only light sanding of the wood was required prior to painting or tuck pointing of the mortar joints). The residual lead levels were significantly below the HUD Guideline of 1  $\text{mg}/\text{cm}^2$  ( $p<0.0001$ ). The average paint removal rates were 76.4 and 119.8  $\text{ft}^2/\text{hr}$  on wood and brick, respectively.
- The lead concentrations determined by ICP-AES analysis and determined by XRF measurements before paint removal on wood were not significantly different ( $p=0.1055$ ); however, these determinations before paint removal on brick were significantly different ( $p=0.0001$ ). The lead concentrations determined by ICP-AES analysis and determined by XRF measurements after paint removal on wood were significantly different ( $p=0.0331$ ); however, these determinations after paint removal on brick were not significantly different ( $p=0.5504$ ).
- The wet abrasive slurry-mixture appears to reduce the fugitive emissions of lead-containing particulate, which serves to enhance the level of environmental protection as well as worker health and safety. The mean area air levels of lead-containing particulate generated during paint removal were significantly below the OSHA PEL of 50  $\mu\text{g}/\text{m}^3$  ( $p<0.001$ ), whereas the mean personal breathing zone levels of lead were approximately three times higher than the PEL. The personal breathing zone levels of lead did not vary significantly with substrate ( $p=0.6396$ ); the area samples showed higher levels of lead during removal of paint from brick than

**Table 5. Characterization of Coal Slag Paint Debris from Wood Substrates**

Technology Combination	Substrate	Site	N	Leachable Lead Level	
				Mean (mg/L)	80% UCL for Mean
Torbo®-Blastox®	Wood	1	2	12.4	39.0
		2	2	15.5	47.9
		5	2	36.0	85.2
		Overall	6	21.3	31.9
Torbo®-PreTox 2000	Wood	3	3	7.7	20.2
		4	3	29.7	39.2
		6	3	7.1	17.5
		Overall	9	14.8	21.4

**Table 6. Characterization of Mineral Sand Paint Debris from Brick Substrates**

Technology Combination	Substrate	Site	N	Leachable Lead Level	
				Mean (mg/L)	80% UCL for Mean
Torbo®-Blastox®	Brick	2	2	1.1	3.9
		4	2	19.5	21.0
		6	2	3.6	9.6
		Overall	6	8.1	13.5
Torbo®-PreTox 2000	Brick	1	2	9.4	11.4
		3	2	5.9	11.9
		5	2	8.3	9.5
		Overall	6	7.8	9.1

**Table 7. Comparisons of Personal and Area Air Concentrations to OSHA PEL**

Technology Combination	Substrate	Type of Sample	N	Mean 8-hr TWA ( $\mu\text{g}/\text{m}^3$ )	t statistic	p-value
Torbo® with Blastox®	Wood	Personal	3	70.9	0.8958	0.7675
		Area	9	20.5	-6.40	0.0001
	Brick	Personal	6	68.4	1.03	0.8257
		Area	18	21.2	-3.36	0.0018
Torbo® with PreTox 2000	Wood	Personal	3	55.1	0.3163	0.6091
		Area	12	26.9	-6.53	0.0001
	Brick	Personal	6	81.5	5.63	0.9975
		Area	16	24.9	-3.60	0.0013

for paint removal from wood (p=0.0463).

- Neither of the two stabilization technologies (Blastox® and PreTox 2000) consistently stabilized the abrasive media lead-based paint waste to reduce the leachable lead content. The 80 percent upper confidence interval for the mean leachable lead concentration in the debris consistently exceeded the RCRA regulatory threshold (5 mg/L). Failure of the technologies to stabilize the lead most likely was due to an inadequate chemical stabilizer-abrasive blend ratio or insufficient application mil thickness of the pre-paint removal coating treatment in the case of Blastox® and PreTox 2000, respectively.

## Recommendations

- Although wet abrasive blasting reduces fugitive emissions of lead-containing particulate generated during removal of paint film from exterior wood or brick masonry, it should be conducted in at least a Class 4 Containment System as specified in SSPC Guide 6, "Guide for Containing Debris Generated During Paint Removal Operations." Air monitoring should be conducted at the perimeter work area to determine the extent that lead-containing particulate are escaping from the work area.
- To maximize the performance of these technologies the user should understand the various factors that may affect the effectiveness of the product to reduce the leachable lead content of the debris. Included are paint film lead content, paint film thickness, paint film condition, type of substrate (e.g., wood, brick, metal), variant particle size, and other potentially significant factors.

**PreTox 2000**—The user of this technology should follow the application optimization procedure specified in the technical guidance provided by the manufacturer. This will ensure that the optimum mil thickness application rate of PreTox 2000 is applied to the lead-based paint coating to be abated.

**Blastox®**—Subsequent to completing this study, the manufacturer of Blastox® revised their technical

guidance regarding the proper blend ratios of abrasive to chemical-stabilizer. The user of this technology should verify that the blend ratio provided by the material supplier is consistent with the recommended blend ratio for a given lead-based paint coating to be abated.

- Due to the inability of these technologies to consistently reduce the leachable lead content in the abrasive media paint debris during this demonstration, all debris should be tested by TCLP prior to disposal. The sampling strategy should be consistent with Chapter 9 "Sampling Plan" of SW-846 "Test Methods of Environmental Testing of Solid Wastes."

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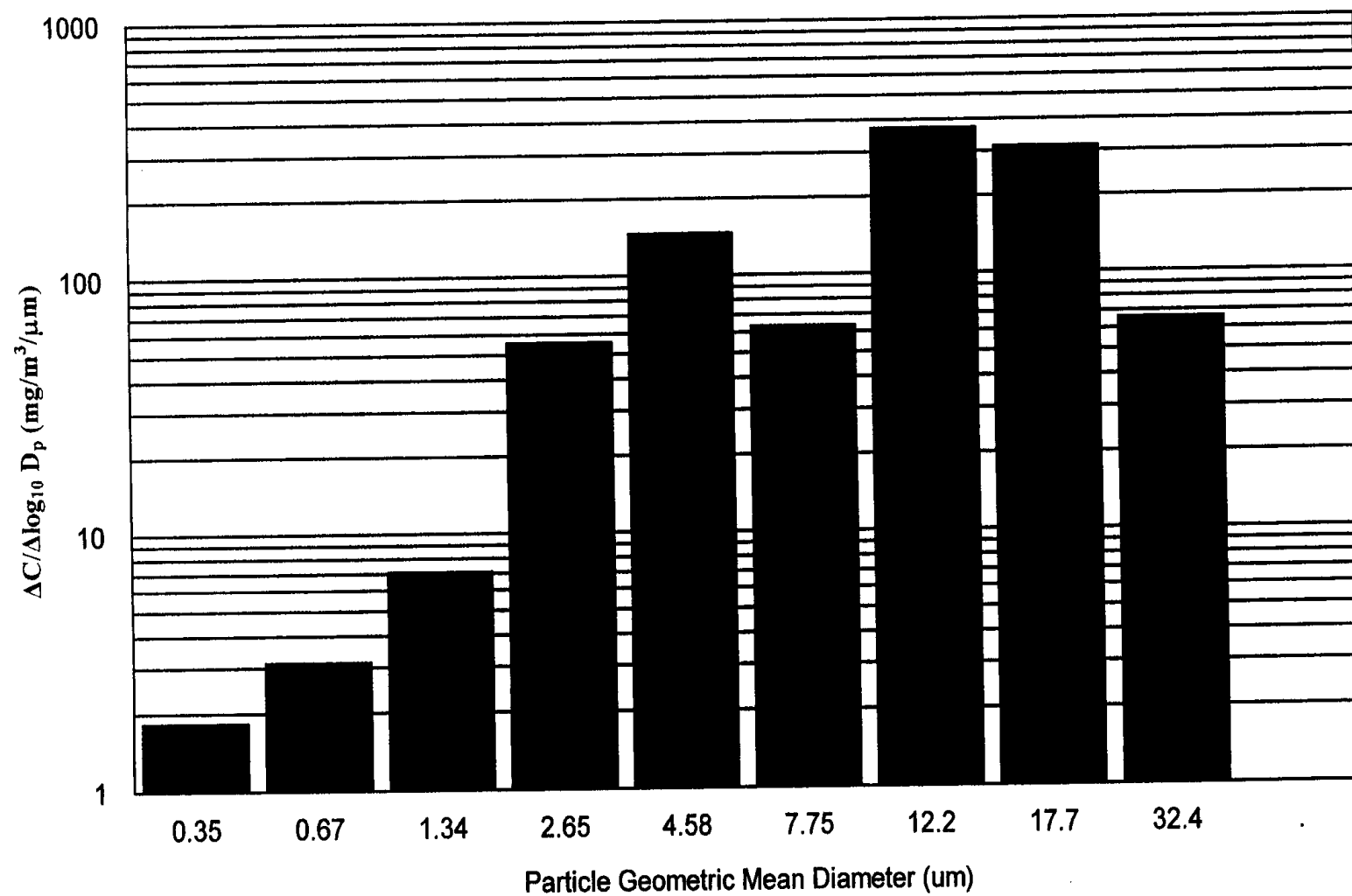
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The complete report, entitled "Field Demonstration of Lead-Based Paint Removal and Inorganic Stabilization Technologies," can be located on the Internet at:

[www.epa.gov/ORD/NRMRL/Pubs/600R01055/600R01055.pdf](http://www.epa.gov/ORD/NRMRL/Pubs/600R01055/600R01055.pdf)

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**Figure 1. Differential Lead Particle Size Distribution During Wet Abrasive Blasting of Brick.**